Signal generator

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Abstract

A signal generator system useful for providing a simulated FLIR display for a flight simulator uses a gated full colour TV image signal of a scene with a chroma-key. Objects to appear 'hot' in the FLIR simulation are coloured and hence gated out of the scene by the chroma-key to be replaced by an appropriate hot FLIR colour in a monochrome display. To provide the background a monochrome display of inverse green is suitable, with added noise on which the hot objects appear white. With an inverse green background, objects to appear hot are coloured orange. Normal full colour display can be shown by using the same chroma-key discrimination and replacing the orange colours with an appropriate camouflage colour.

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(54) **Signal generator**

(57) A signal generator system useful for providing a simulated FLIR display for a flight simulator uses a gated full colour TV image signal of a scene with a chroma-key. Objects to appear 'hot' in the FLIR simulation are coloured and hence gated out of the scene by the chroma-key to be replaced by an appropriate hot FLIR colour in a monochrome display. To provide the background a monochrome display of inverse green is suitable, with added noise on which the hot objects appear white. With an inverse green background, objects to appear hot are coloured orange. Normal full colour display can be shown by using the same chroma-key discrimination and replacing the orange colours with an appropriate camouflage colour.

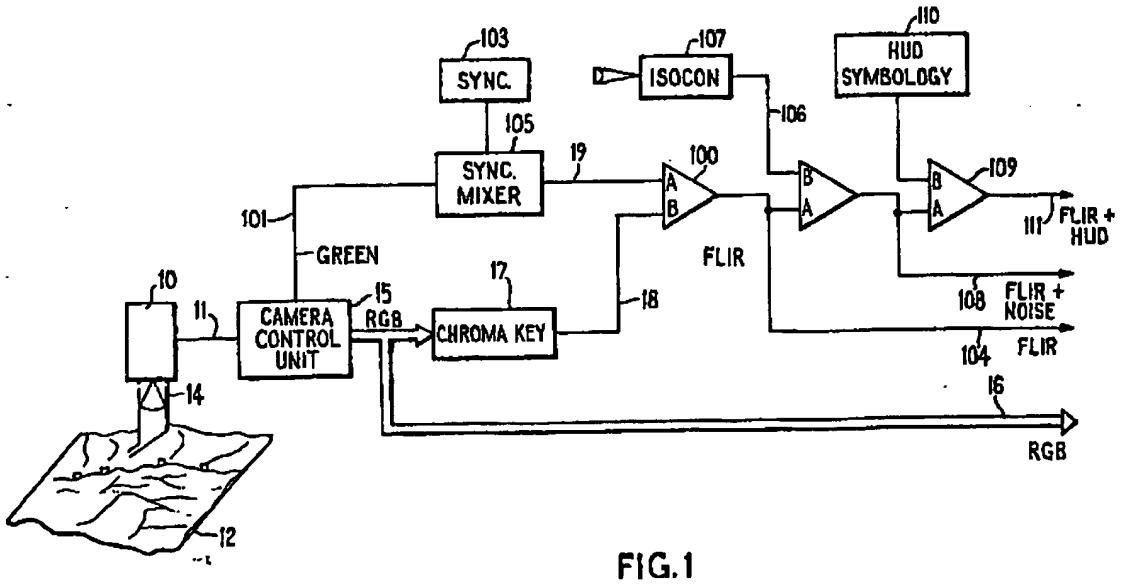

FIG.1

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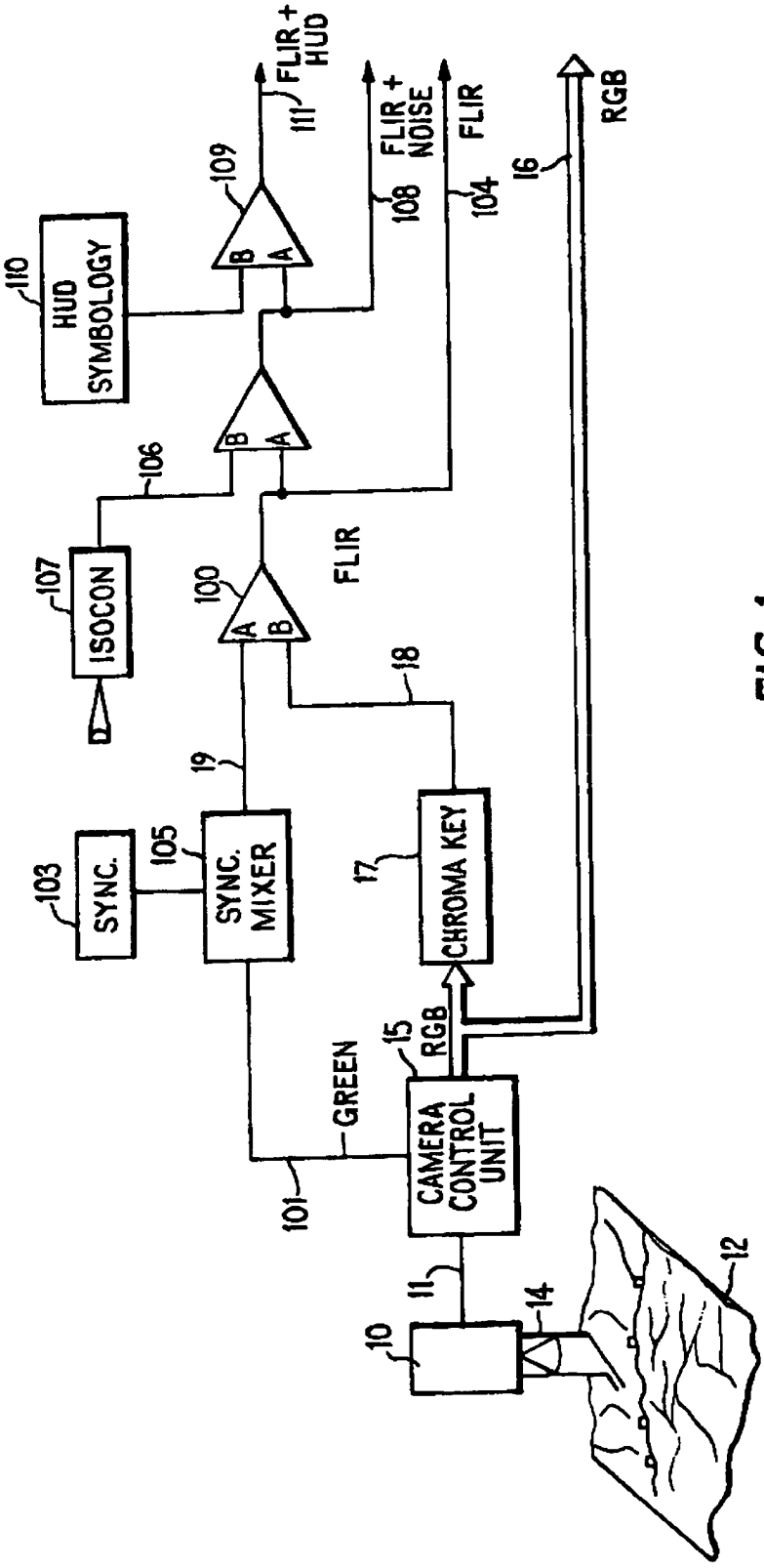
FLIR + HUD
111
FLIR + NOISE
108
FLIR
104
RGB
16
109
B
A
110
HUD SYMBOLOGY
106
107
ISOCON
100
A
B
FLIR
18
19
103
SYNC.
105
SYNC. MIXER
17
CHROMA KEY
15
RGB
GREEN
101
CAMERA CONTROL UNIT
11
10
14
12

FIG.1

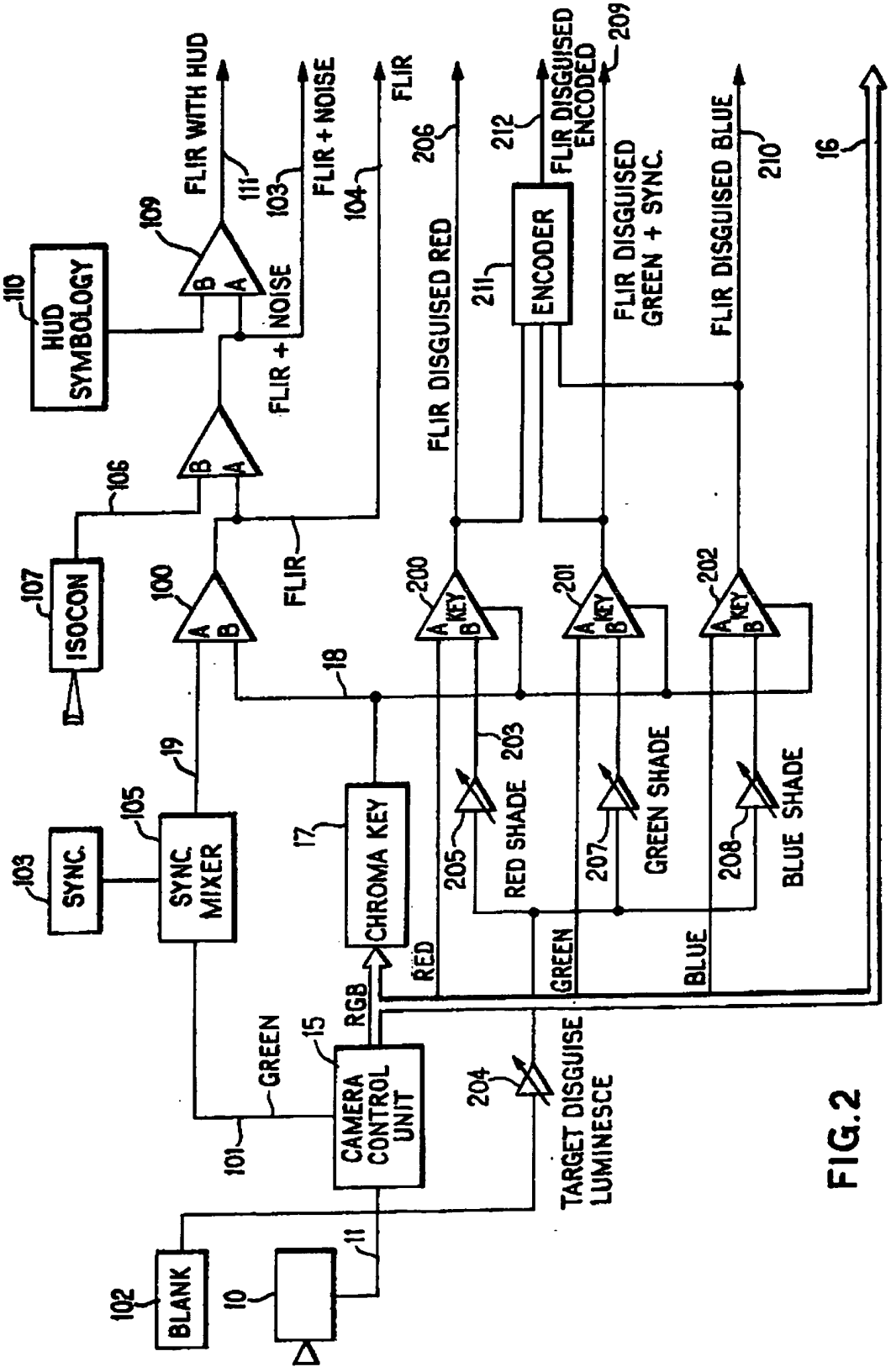
FLIR WITH HUD
FLIR + NOISE
FLIR
FLIR DISGUISED RED
FLIR DISGUISED ENCODED
FLIR DISGUISED GREEN + SYNC.
FLIR DISGUISED BLUE
HUD SYMBOLOGY
ENCODER
ISOCON
SYNC.
SYNC MIXER
CHROMA KEY
CAMERA CONTROL UNIT
BLANK
RED SHADE
GREEN SHADE
BLUE SHADE
TARGET DISGUISE LUMINESCE
RED
GREEN
BLUE
RGB
KEY
109
110
111
103
104
206
212
209
211
106
107
100
200
201
202
105
19
17
18
203
205
207
208
204
15
101
102
10
11
16
210

FIG.2

SPECIFICATION

Signal generator

This invention relates to signal generators and in particular to signal generators for providing signals of the type characteristic of an infrared sensor, and useful for flight simulation.

In aviation it is desirable to provide enhanced vision in conditions of poor visibility, and to this end devices based on infrared sensors have been developed. Useful signals may be obtained from such sensors when normal visibility is inadequate, since they respond to wavelengths outside the visible spectrum and are therefor substantially unaffected by darkness or obscuration. Infra red sensors are usually mounted on an aircraft to give a forward view from the aircraft presented as an image in a television format. Such equipment is referred to in the art as a Forward Looking Infra-red (FLIR) Sensor. A feature of Infra-red images is that warm objects stand out, thus enabling such objects to be distinguished from their surroundings. Infrared sensors therefor are useful in military aviation for reconnaissance and weapon aiming.

Unfortunately the high cost of aviation limits the opportunity for training and experimental work on real aircraft. As a solution to this problem flight simulators have been developed in which a camera translates over a model board representing the ground to provide a signal which may be relayed to a mock cockpit to simulate flight by a television display. These days there is need to simulate FLIR in addition to normal vision. To this end simulators having two model boards representing the same scene, one in normal color and one in FLIR image, and ganged cameras moving in synchronism over the boards, and simulators in which a FLIR sensor is provided in addition to a standard camera and the board models heated, have been tried. Both schemes present formidable problems and expense, and the opportunities for training and research in the environment of an infra-red equipped aircraft remain restricted.

According to the present invention a signal generator for providing a signal of the type characteristic of an infra-red sensor includes:

a color video camera providing image signals representative of a scene,

a chroma Key discriminator for identifying signals representing images of a predetermined colour,

and means for brightening image signals representing such images.

Preferably the brightening is applied to a monochrome signal and the brightening level is such that contrast detail on the model is preserved in the image signal, the preferred monochrome signal being inverse green. Advantageously a plurality of chroma Key discriminators, each responsive to a different Key is included. In a preferred embodiment of the present invention the scene is provided by a model board and a target of a predetermined colour selected from the colours not normally present in the scene modelled. The simulated signal may be mixed with other signals, for example a noise signal or head up display symbology as appropriate to the simulation required.

In accordance with a further aspect of the present invention the colour camera signals are replaced by signals representing alternative colours when an image signal of predetermined colour is received such that both FLIR signals and signals representative of normal vision are simultaneously available. Advantageously the replacement is effected by mixers responsive to chroma Key detector output. A plurality of detectors each responsive to a different predetermined colour may be included.

In order that features and advantages of the present invention may be appreciated, embodiments will now be described with reference to the accompanying diagrammatic drawings of which:—

Fig 1 represents a FLIR simulator, and

Fig 2 represents a further embodiment of the present invention providing simultaneous normal vision and FLIR simulations.

The embodiments relate to FLIR simulation, but it will be appreciated that the present invention may be equally applicable to all infrared-sensors, including for example night vision goggles and infra-red target sights.

The first embodiment to be described is a signal generator for providing a signal which simulates a FLIR sensor signal for a flight simulator and in which a colour camera 10 provides a signal 11 representative of a scene on a model board 12 via optical unit 14.

The details of optical unit 14 and how it may be translated with respect to the model board 12 are well known in the flight simulation art and will not be expanded here. Signal 11 is processed by a known camera control unit 15 to provide Red, Green and Blue (RGB) colour video signals 16 for display by a television system.

In accordance with the present invention a chroma Key discriminator circuit 17 receives RGB signals 16 to produce an output whenever a signal representative of an image of a predetermined colour is received. The Key of the discriminator 17 is set by means known in the art to be responsive to a colour not normally present in the scene represented by model board 12 and models of this predetermined colour placed on the board wherever a simulated FLIR warm object is required. Key signal 18 is used to brighten up a monochrome signal 19 from camera control unit 15 via mixer 100 such that an image similar to that produced by a warm target is provided when signal 104 is fed to a television display system (not shown). In the embodiment an inverse green signal 101 is mixed with a synchronisation signal 103 to provide composite monochrome signal 19 at the output of mixer 105. During the course of making the present invention it has been established that inverse green provides a particularly good FLIR simulation, however it will be appreciated that any signal having a luminance component may be used. The bright up level provided by mixer 100 may be adjusted such that contrast detail of the image within the brightened

area is preserved, thus enabling some details of the model to be observed as would be expected with some types of infra-red sensors.

The FLIR signal 104 provided by this embodiment of the present invention may be of very high quality and in excess of that to be expected with operational equipment. Further in accordance with the invention FLIR signal 104 may be mixed with a signal 106 from a noise source 107 for example a capped LLTV camera, to provide a noisey simulation signal 108 which has been found in practice to realise a very effective FLIR simulation. FLIR signal 108 may further be mixed by mixer 109 with symbology for head up display (HUD) from signal generator 110 to provide a signal 111 suitable for transmission to any raster HUD equipped cockpit mock-up. Use of this signal has the advantage that FLIR background and HUD symbology may be displayed by a single television system.

In an alternative embodiment of the present invention a plurality of chroma Key discriminator circuits are provided, each with its key set to a distinct predetermined colour not normally present on the model board. Each chroma key discriminator may be used to provide a FLIR signal as described above including a brightened up image of models of the colour for which the key has been set. Each FLIR signal may be selected, or signals mixed to provide a changing FLIR scene. In particular selection of different FLIR signals can provide for target movement between for example an outboard and a return flight. The need for repositioning the models between simulations may also be avoided. The selected FLIR signal may be mixed with a noise signal and or HUD symbology as described above.

A further embodiment (Fig 2) of the present invention will now be described:

Where parts of the embodiment have the same functions as the embodiment of Fig 1 common reference numerals have been used. In this embodiment the full RGB signal 16 is available as well as the FLIR simulation signals 104, 108 and 111, and in addition further signals from mixers 200, 201 and 202. Mixers 200 receives a red signal from camera control unit 15 at a first input A and signal 203 at a second input B. Signal 203 is derived from blanking signal generator 102 and is level set by luminance control 204 and shade control 205. Mixer 200 is of a known type having a third input key which acts as a control input to select a signal on input A or a signal on input B. The A input is normally selected so that the red signal is present at output 206. The key input if fed from chroma key discriminator 17 so that input B is selected whenever a signal representing an image of the predetermined colour is received. In this way in output signal 206 the FLIR image of the model is replaced by a red colour signal set by controls 204 and 205. Mixers 201 and 202 are similarly fed from a green signal and a blue signal respectively at their A inputs and signal controlled by luminance control 204 and shade controls 207 and 208 respectively. Thus output signals 209 and 210 have their FLIR image components respectively replaced by a green shade and a blue shade when a signal representing a model of predetermined colour is detected by chroma key discriminator 17. It will be realised that output signals 206, 209 and 210 respectively constitute RGB signals which represent the model board scene normally expect that when the predetermined colour is detected it is replaced by a signal the luminance of which is set by control 204, and the red, green and blue components respectively by controls 205, 207, 208.

The present embodiment has many advantages in flight simulation. The models of predetermined colour which provide a FLIR warm target simulation on FLIR outputs 104, 108 and 111 and which would otherwise appear out of context on a normal display of RGB colour signals may be disguised by replacing them with luminance and colour levels consistant with their surroundings on the model board. For example a model of a tank coloured orange may be used to provide a FLIR signal and yet be camouflaged green to merge with surrounding trees during a normal vision simulation. The output signals 206, 209 and 210 may be encoded in accordance with known video signal processing principles by an encoder 211 to provide a video signal 212 having luminance and chrominance components. It will be realised that by means of the present invention a full FLIR and normal vision simulation can be simultaneously provided from a single colour camera and model board.

It will be appreciated that RGB mixers may be controlled from a plurality of chroma discriminators, each keyed to a different predetermined colour so that a plurality of different disguises may be provided during the same simulation. For example an orange model and a violet model may both give rise to a FLIR bright up image, orange models being disguised green (eg in forest) and violet models brown (eg in ploughed field).

It will further be appreciated that with a simulation in accordance with the present invention models may be disguised or highlighted by setting chrominance and luminance levels. For example, pilot performance in spotting a model tank in a first camouflaged and second contrasting appearance may be compared.

CLAIMS

1. A signal generator for providing a signal of the type characteristic of an infra-red sensor which includes:

a color video camera providing image signals representative of a scene,

a chroma Key discriminator for identifying signals representing images of a predetermined colour,

and means for brightening image signals representing such images.

2. A signal generator as claimed in claim 1 in which the means for brightening the image is applied to a monochrome signal.

3. A signal generator as claimed in claim 2 in which the monochrome signal is inverse green.

4. A signal generator as claimed in claim 2 also including means for the mixing of additional signals with the monochrome display.

5. A signal generator as claimed in claim 4 in

which the additional signals are noise.

6. A signal generator for providing a FLIR display simulation from a full colour video display of a flight simulator model board which includes

a colour video camera providing image signals representative of the model board,

a chrome key discriminator for identifying signals representative of images of objects of a predetermined colour on the model board,

means for brightening image signals of said objects,

means for providing an inverted green monochrome display mixed with said brightened image signals and with noise signals

and means for displaying said simulated FLIR display.

7. A signal generator for providing a FLIR display simulation from a full colour video display of a flight simulator model board which includes

a colour video camera providing image signals representative of the model board,

a chroma key discriminator for identifying signals representative of images of objects of a predetermined colour on the model board,

means for replacing said identified signals with signals representing an alternative colour or colours,

means for providing an inverted green monochrome noisy display,

means for mixing said alternative colour or colours with the full colour video signals and with the inverted green monochrome noisy display so that signals of FLIR simulation and those representative of normal vision are simultaneously available.

8. A signal generator substantially as hereinbefore described with reference to and as illustrated in the accompanying Figures 1 and 2.

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